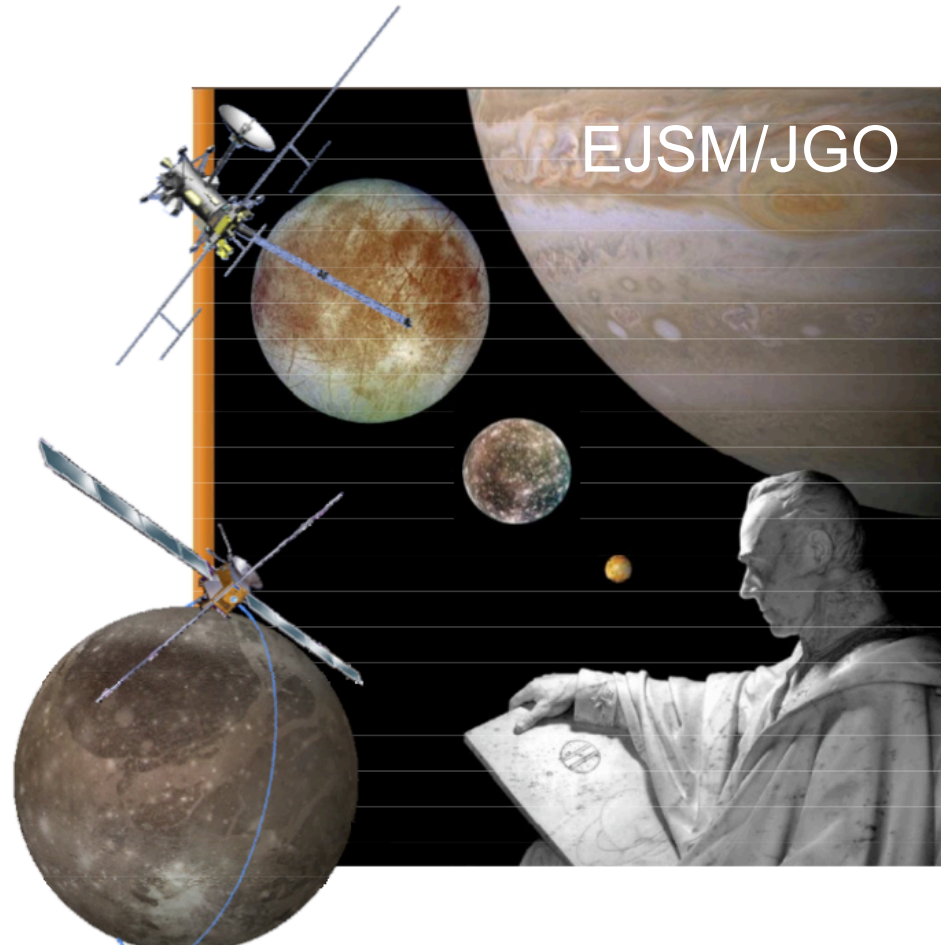
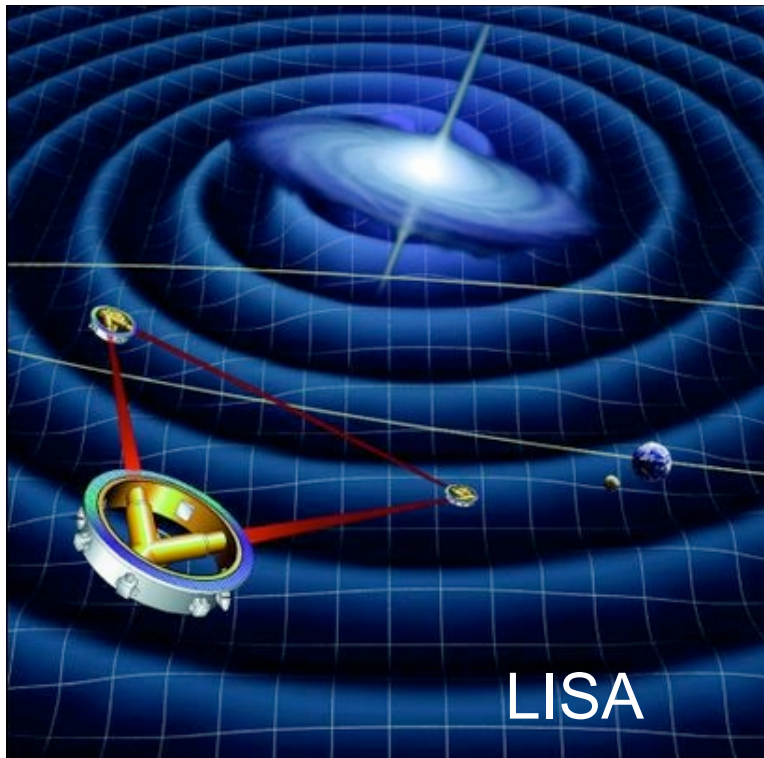


IXO workshop: Closing Remarks

Kirpal Nandra

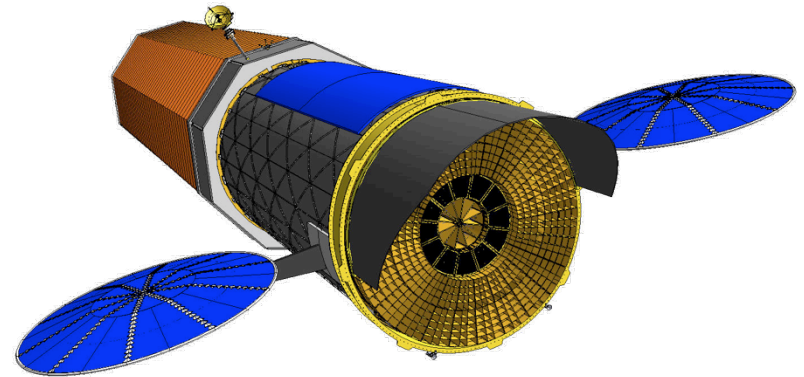
THE COMPETITION (IN EUROPE*)



*But everything also depends on the decadal(s)
+JAXA process also beginning

THE WAY FORWARD

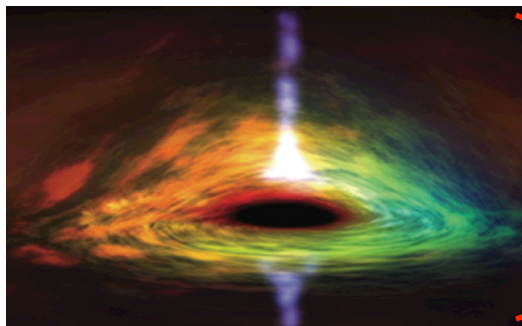
- **NEED TO DEMONSTRATE**
 - Exciting Science Goals
 - Capabilities that meet those goals
 - Robust design delivering requirements (within margins)
 - Technology that enables the design
 - A realistic (and harmonious) schedule
 - Affordable costs



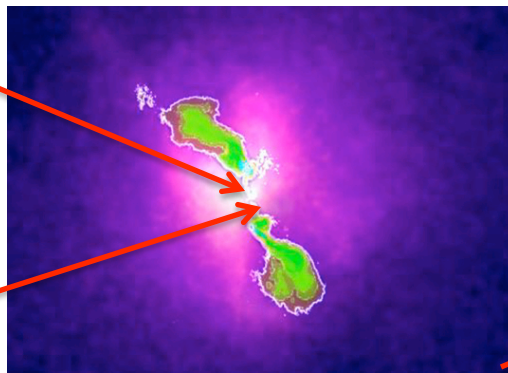
1. Exciting Science Goals

The International X-Ray Observatory (IXO) will address fundamental and timely questions in astrophysics:

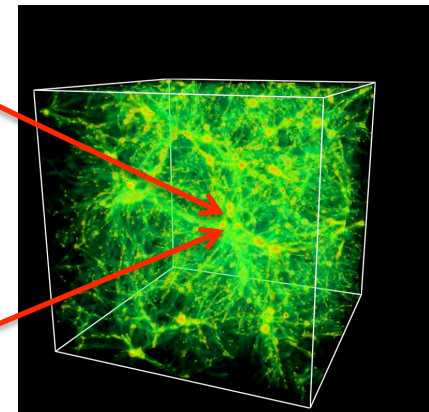
- What happens close to a black hole?
- When and how did super-massive black holes grow?
- How does large scale structure evolve?
- What is the connection between these processes?



Black Hole Accretion



Hydra A Galaxy Cluster

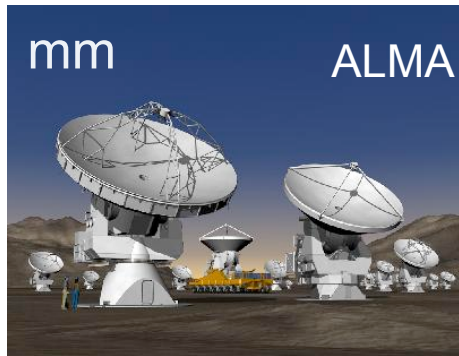


Cosmic Web

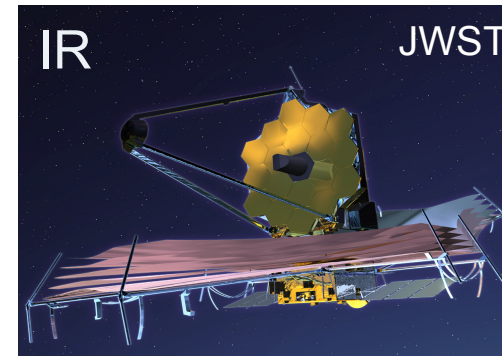
Future Great Observatories



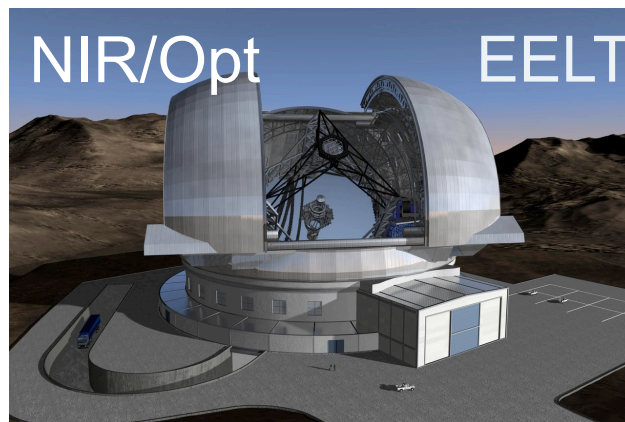
Rawlings



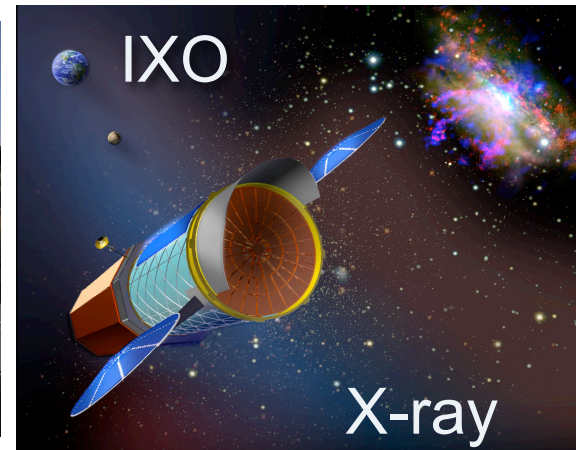
Maiolino



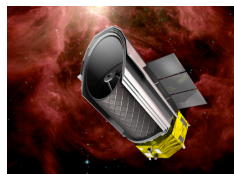
Maiolino



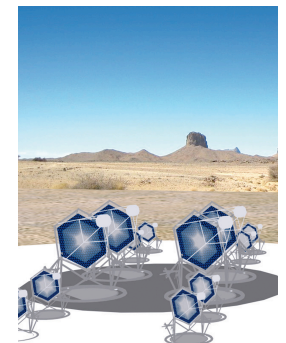
Rosati



Everyone else



SPICA FIR
Nakagawa



CTA VHE γ
Sol

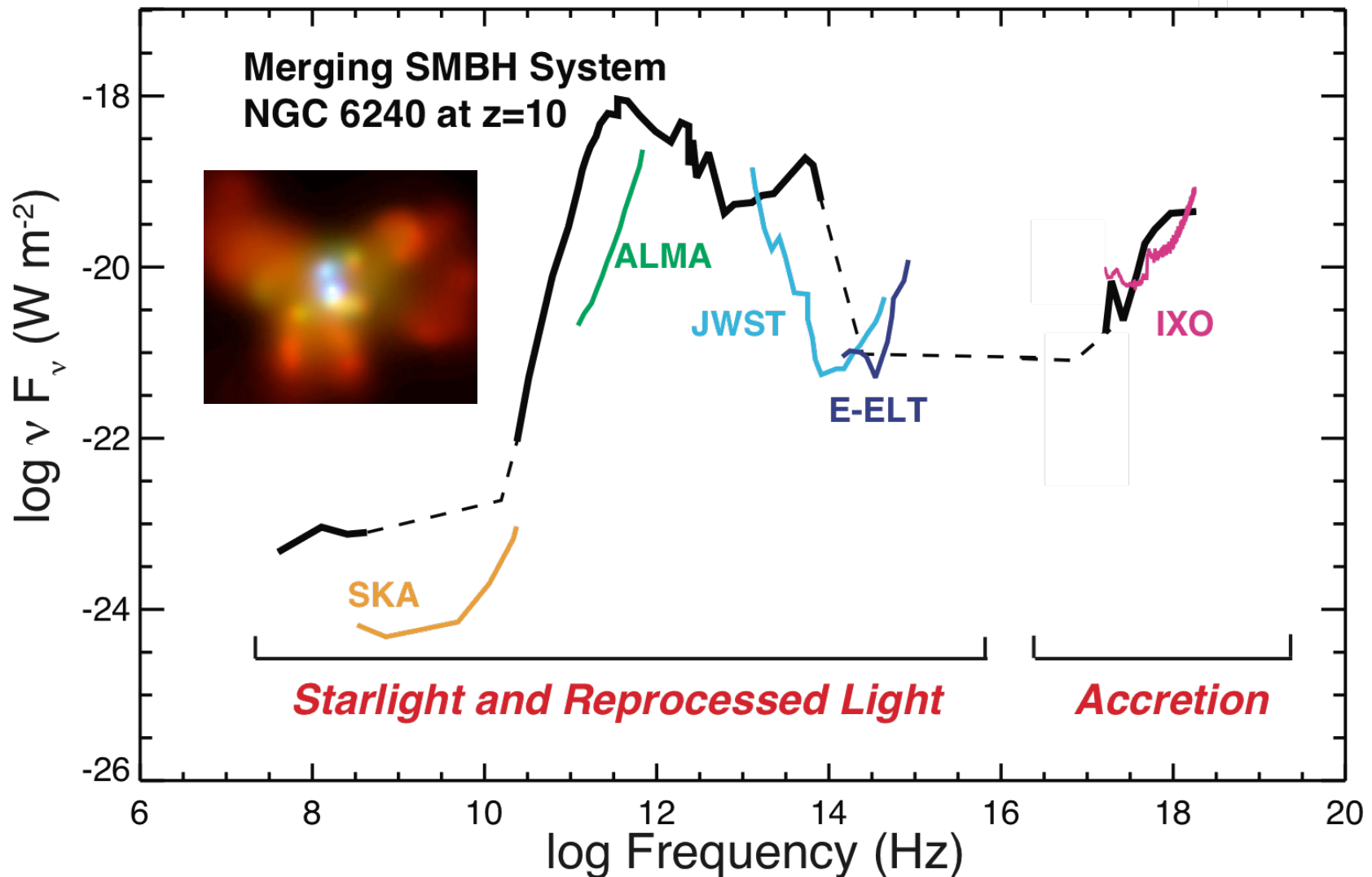
IXO/ELT SYNERGY

- **E-ELT SCIENCE WORKSHOP, LONDON, Jan 13-15 2010**
 - When did stars assemble into today's galaxies?
 - What is the metal enrichment history of galaxies and the IGM?
 - Feedback: what sources are responsible for quenching star formation?
 - First light: What is the nature of the earliest galaxies?
 - What is the nature of the host galaxies of super-massive black holes and gamma ray bursts?
 - What sources are responsible for reionisation?
 - How many types of matter exist? What is dark matter? Where is it?
 - What is dark energy? Does it evolve? How many types are there?

IXO/ELT SYNERGY

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 - When did stars assemble into today's galaxies?
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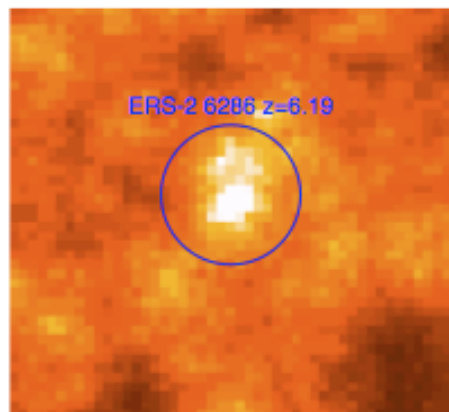
Multiwavelength Galaxy Evolution



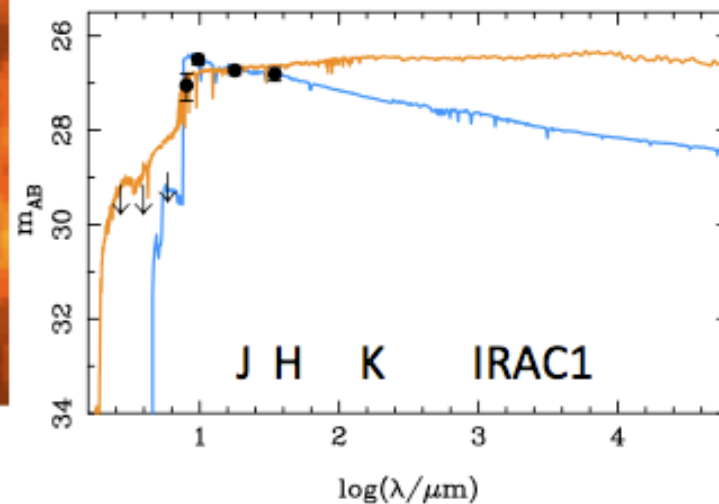
THE FIRST SMBH: IDENTIFICATION WITH JWST

$z=6.19$ low L_X AGN candidate in the CDF-S

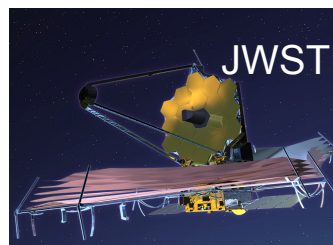
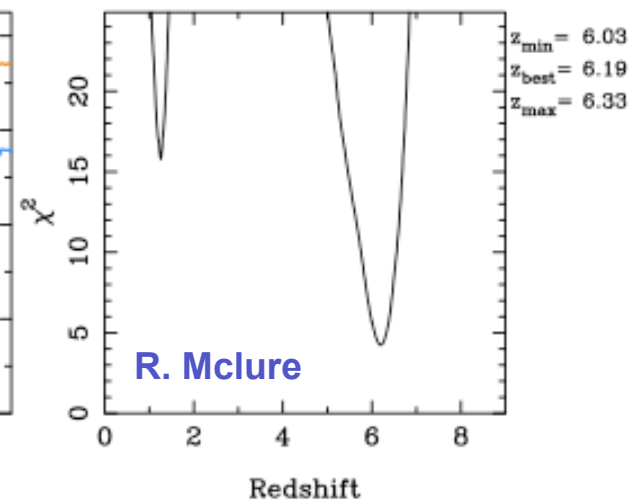
$$L_X = 3 \times 10^{43} \text{ erg/s} \quad \text{Flux} = 6 \times 10^{-17} \text{ erg cm}^{-2} \text{ s}^{-1}$$



CDFS 2Ms

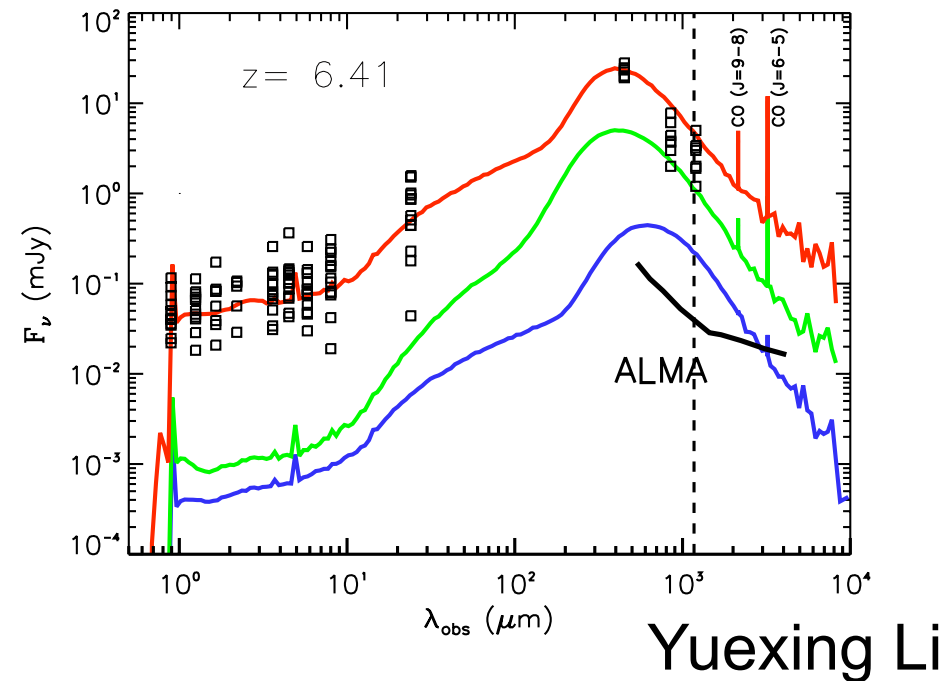
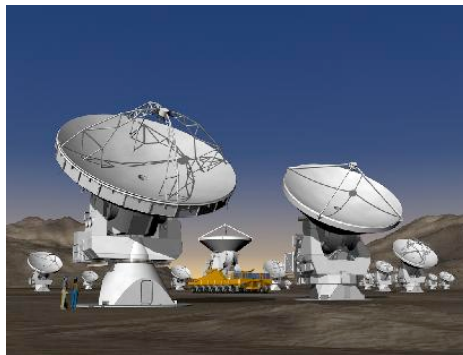


NIRSPEC range



NIRSPEC reaches
 $J_{AB} \sim 26.5$ in 100ks

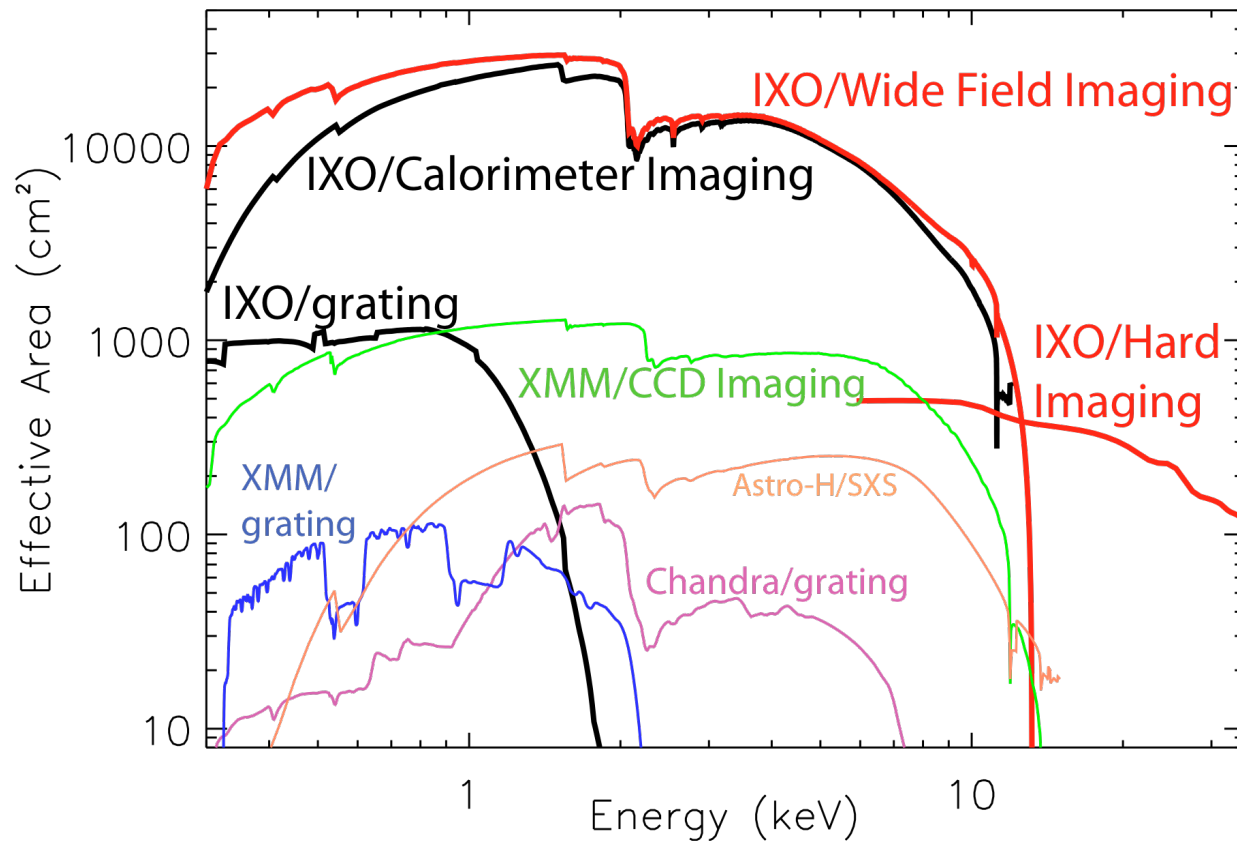
THE FIRST SMBH: CHARACTERISATION WITH ALMA



CO and [CII] 158 μ m lines will yield not only redshifts but molecular gas mass, dynamical mass, plus (spatially resolved) kinematics, metallicities, densities, temperatures etc. for high z AGN found by IXO

2. Capabilities delivering science

IXO is a Vast Improvement over Existing Missions

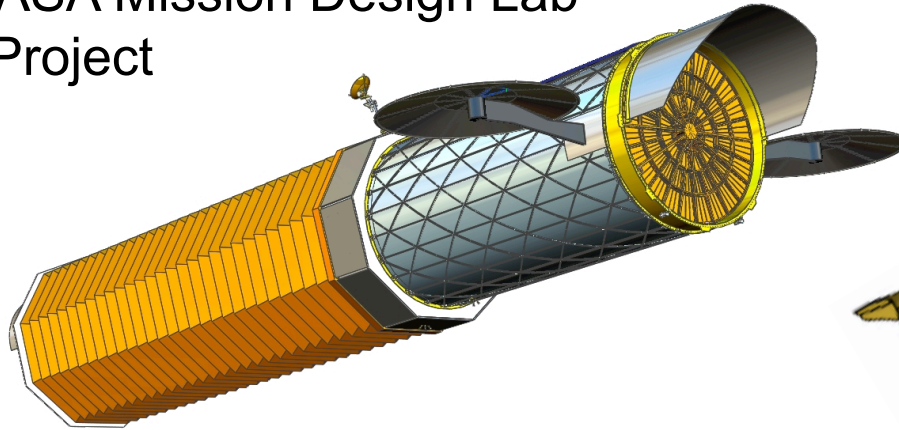


Effective area a factor of $>10x$ of current missions
Spectroscopy capabilities $>100x$ of current missions

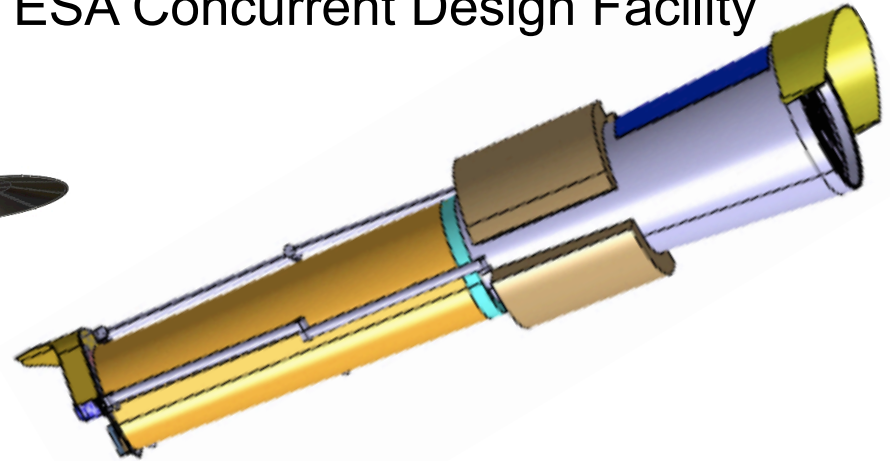
3. Robust system design

Four separate IXO Mission Studies

NASA Mission Design Lab
+Project



ESA Concurrent Design Facility



+ESA Industrial System Studies:

- Thales/Alenia Space
- Astrium UK

+JAXA studies

Mission Life

5 years required, 10 years goal

Launch

December 2021

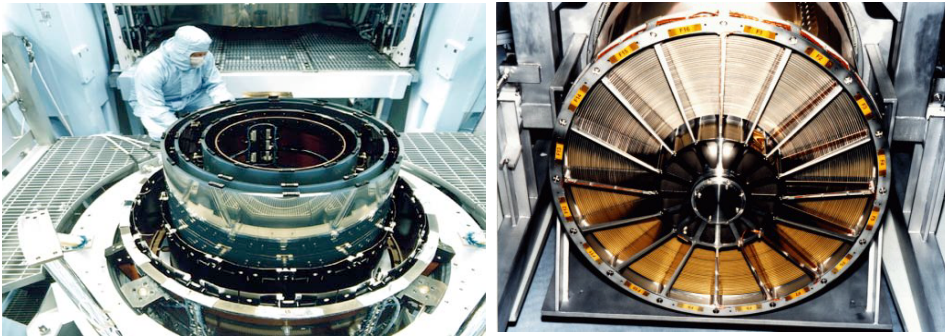
Atlas V 551 or Ariane 5

Max Liftoff Mass: 6425 kg

Orbit

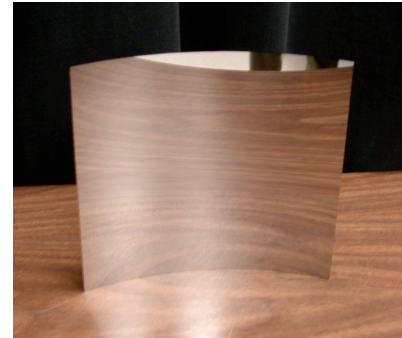
L2 800,000 km semi-major axis halo orbit

4. Mission-enabling technology

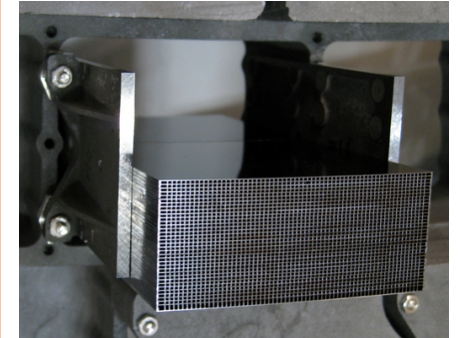


CHANDRA
0.5" HEW
18500 kg/m²

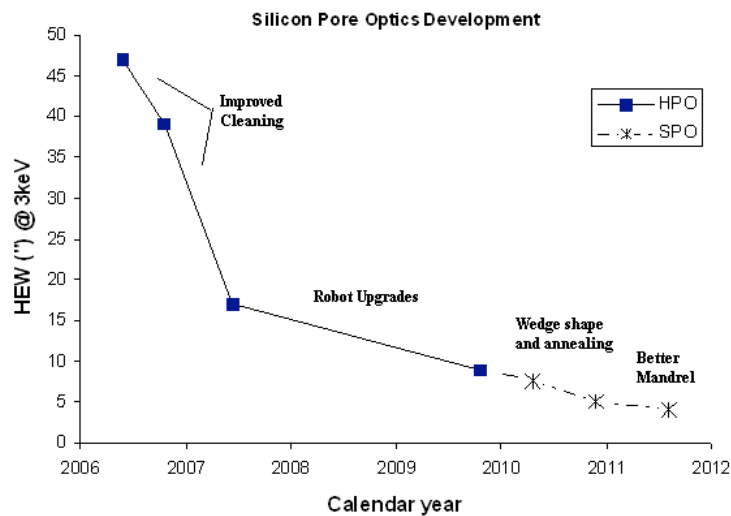
XMM-NEWTON
14" HEW
2300 kg/m²



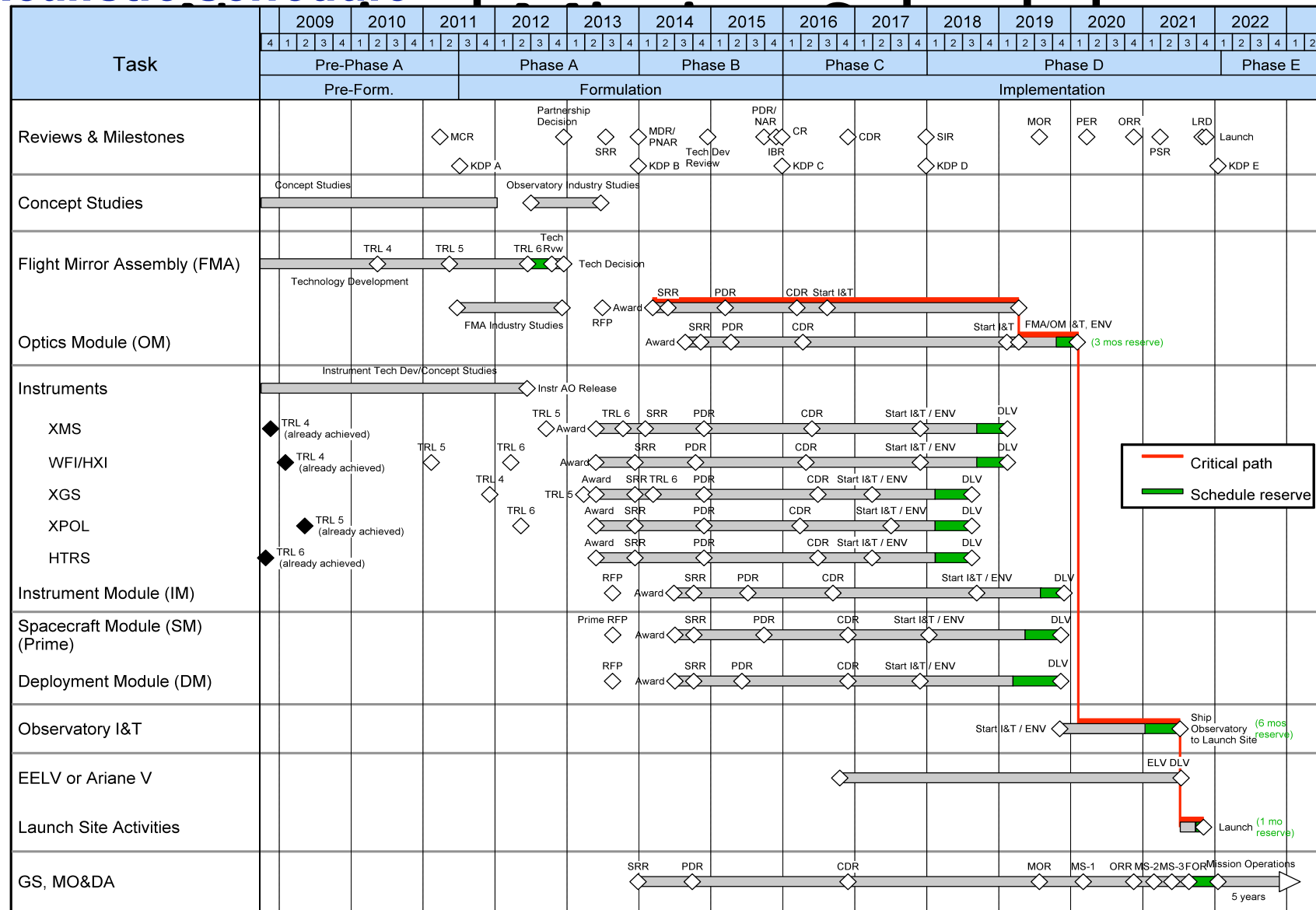
Slumped Glass
5" HEW
~270 kg/m²



Si-HPO
5" HEW
~200 kg/m²



5. Realistic schedule



5. Realistic schedule

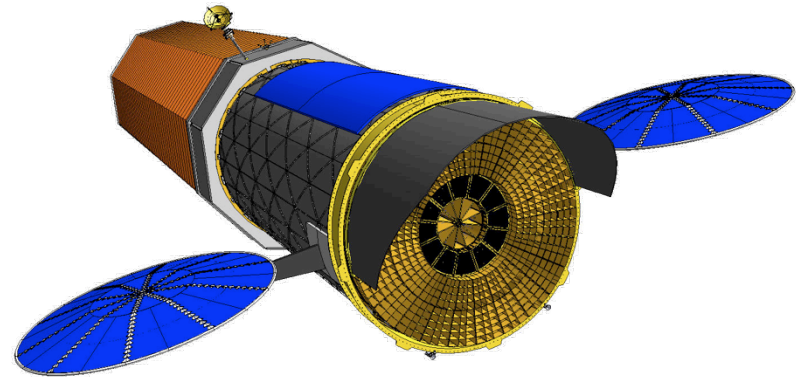
2021 IS FEASIBLE*

*Confirmed by NASA MDL, Aerospace corp, ESA CDF, Industrial studies TBD

THE WAY FORWARD

■ NEED TO DEMONSTRATE

- Exciting Science Goals
- Capabilities that meet those goals
- Robust design delivering requirements (within margins)
- Technology that enables the design
- A realistic (and harmonious) schedule
- Affordable costs



IXO CAN BE DONE!